(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 256 841 B2**

(12) # NEW EUROPEAN PATENT SPECIFICATION

(45) Date of publication of the new patent specification : **02.11.95 Bulletin 95/44**

(51) Int. Cl.[6] : **H01B 5/00,** H01B 5/12, H01B 5/10

(21) Application number : **87307108.8**

(22) Date of filing : **11.08.87**

(54) **Fence tape and multistrand fence wire.**

(30) Priority : **11.08.86 NZ 217168**

(43) Date of publication of application : **24.02.88 Bulletin 88/08**

(45) Publication of the grant of the patent : **17.10.90 Bulletin 90/42**

(45) Mention of the opposition decision : **02.11.95 Bulletin 95/44**

(84) Designated Contracting States : **DE FR GB NL SE**

(56) References cited :
EP-A- 0 104 669

(56) References cited :
CH-A- 415 781
FR-A- 2 203 578
FR-E- 12 921
GB-A- 748 559

(73) Proprietor : **GALLAGHER ELECTRONICS LIMITED**
Kahikatea Drive
Hamilton 2001 (NZ)

(72) Inventor : **Monopoli, Dion Vincent**
20 Te Ata Place
Dodson's Valley Nelson (NZ)

(74) Representative : **Adkins, Michael et al**
4 Dyer's Buildings
Holborn
London EC1N 2JT (GB)

EP 0 256 841 B2

Description

This invention concerns electric fence wire and fence tape used by graziers and others.

The use of electric fence tape and wire is well known in pasture management wherein strip grazing is an effective mode of control. Electrified fencing may also be used on plantations to exclude wild animals. Whole paddocks or fields may be given a protected perimeter in this way. In doing so the installer may have to electrify large distances. The installer must then consider whether at such large distances the power at his disposal will deliver an adequate shock. Here he must include the effect of weather because diurnal variations in temperature and humidity may be extreme. There is always a tendency for long stalks of grass to blow against the tape or wire and intermittently earth the current.

DESCRIPTION OF THE PRIOR ART

The three problems arising from the use of tape or wire are as follows. Firstly the breakage of the conductors due to frequent reeling or rearrangement during strip grazing, overtensioning during installation, knot tying and wind flutter when the tape or wire is strung out. Breaks in conductors are not readily detectable and thus the breakages of individual wires continue until, without warning, the tape or wire ceases to conduct. Conductivity in the field also varies from lab test results depending upon individual installers, local conditions and weather. Secondly, the length of tape or wire which can be electrified to the correct deterrent potential, with a reel energizer, even with the provision of six conductor strands is approximately 1500m. This is equivalent to a square paddock with a side of less than 400m in length.

Whereas paddocks with a smaller total perimeter than 1500m can be sufficiently protected by one energizer, paddocks of the same area but greater perimeter, or paddocks of larger area such as are now common in larger overseas countries, require two or more energizers to service the length of wire involved.

Thirdly, the wire or tape is not sufficiently visible under all conditions to make a satisfactory boundary. Fog, rain, dust and darkness all reduce the visibility of fence tape under field conditions. In addition the behaviour of animals confined by the tape is also a consideration. Animals such as horses may be moving speed within a taped enclosure. Herd animals such as cows, may physically push others of the herd toward the tape. Manufacturers usually seek to improve the tape so visibility by imparting those colours to the tape which they believe maximise visibility.

Orange, yellow, yellow and black stripe are all available for the selection of these colours has not been based on establishing contrast with a prodominent field colour which is grass or tree colour and to a lesser extent sky colour. The choice of the available tape colours appears to have been suggested by the selection of high visibility colours already successful in cityscapes where visibility in low intensity light was the guiding factor.

Our work has shown that the establishment of six conductor strands of stainless steel wire has served reasonably well when combined with a woven ribbon of polyethylene filaments or a unidirectionally twisted triple strand polyethylene filament line with stainless steel wires included among the strands. Electrical conduction has naturally remained at the former level and the number of energisers required for an effective installation increases as the length of fence to be electrified increases. Electrical conduction levels do not seem to have been a consideration in the prior art. In EP-A 0 104 669 it is thermal conduction of the wires in the tape which is seen as objectionable. The proposal in that disclosure for maintaining strength and conductivity in the face of grass fires has been to use a particular aluminium alloy in combination with textile components with good flame resistance. The alloy selected is Alclad 5056 which has an alloy core and a metallurgically bonded aluminium alloy coating that is anodic to the core. The purpose of the coating is electrolytic protection of the core against corrosion. We have found the electrical conductivity of aluminium to be useful for out purposes but aluminium as a metal is somewhat reactive chemically and its use as a small gauge wire in a fence wire assembly can lead to premature failures which makes the selection of the particular alloy quite significant.

The disclosure points out that tinned copper as a conductor improves conductivity but is too mechanically weak to withstand breakage during use particularly during winding and unwinding the wire from a reel for example when strip grazing is carried out and the wire is reeled frequently and moved. Tinned copper is not therefore seen as technically feasible for fence wire or fence tape.

British Patent Specification No. 748 559 (Plessey) described a flexible conductor wire for loudspeakers which is made from a combination of copper and allow for the purpose of improved flexibility and strength.

European Patent specification 0 104 669 (corresponding to EPA 83110522.6 referred to above) in the name of Bay Textiles identifies problems in relation to the strength of existing electric fence wires. However, the solution posed in this patent specification is directed towards modifying conventional carrier materials which are used in electric fence wire and tape manufacture.

The aim of the present invention is primarily to improve conductivity and to minimise conductivity losses in the event of a breakage of one or more of the conductive wires. Nevertheless, bearing this in mind, it is still an aim of the present invention to provide electric fence tapes which are strong.

SUMMARY OF THE INVENTION

According to the present invention, there is provided an electric fence tape or wire comprising a textile support structure and two groups of spaced conductive filaments threaded or braided with the support structure so that the filaments are exposed at intervals along the structure and spaced apart but in close proximity with respect to one another, characterised in that each of the said two groups of conductive filaments has distinct mechanical and electrical qualities, wherein the first group of the filaments has superior electrical conductivity relative to the second and the second group of the filaments has superior resistance to tensile force relative to the first, and wherein the first and second groups each contain at least two filaments, whereby the electric fence tape or wire offers resistance to tensile forces while maintaining relatively good electrical conductivity.

Preferably the conductors which are intended to resist the fatigue forces are made of stainless steel wire. The copper core or aluminium alloy conductors may constitute from 25-75% but are more usually 33 to 66% of the total number of wire conductors. Naked copper if exposed to weather tends to collect a surface coating of green basic copper carbonate so we prefer to use tinned copper but other forms of electrolytic protection are also acceptable. Copper is too ductile for prolonged use in fence wire but its performance is helped by annealing. The aluminium alloy wire may have a coating which is anodic to the core of the wire. Contrary to our expectations the electrolytic problems which were predicted for the use of dissimilar metals lying on wet textile strands have not proved in the field to be troublesome.

While a number of metals and alloys have conductivities which are larger than stainless steel, in practice only copper, aluminium and aluminium alloys are sufficiently cheap, conductive and commercially available in quantity to be of interest to manufacturers in this field. The electrical conductivities are quoted below:

Copper $5.81 \times 10^7\ \Omega^{-1}\ m^{-1}$

Aluminium $3.54 \times 10^7\ \Omega^{-1}\ m^{-1}$

The textile strands may be a polyolefin for example polyethylene or polypropylene, a polyester such as those obtainable under the trade mark "TERYLENE", polyamides such as nylon and cellulosic materials such as rayon. Although the term "fence wire" includes a single strand of tensile steel wire which is galvanised and used worldwide by fencers the meaning in this context is a cord comprising usually three or more bunches of monofilaments which are unidirectionally twisted and into which the wires have been overfed so that although the strands are twisted firmly together the wires may not lie snugly within the twisted strands but may project from the surface of the cord whereby contact with a browsing animal is made more possible.

Likewise the strands may be braided. For this purpose the number of strands may increase to say five or more, the twisting of the strands giving the requisite strength but the braiding forming a structure which is in effect one strand thick but several strands wide when viewed face on. Again the wires may be overfed so as to form nodes and antinodes along the cord or braid.

The strands may be monofilaments which are some what easier to handle than bunches of multifilaments. The tape may be woven so that the warp strand, the weft strand on both warp and weft strands may be white. Perhaps the best visibility results from all the textiles structure being white but good visibility results when the warps are colourless and only the weft is white. Visibility may be increased by filling the strands with titanium dioxide and by the optional inclusion of an optical whitener. Unfilled fibres deteriorate quicker in the field.

As the minimum tape width is 10mm the weft need not be beaten up between picks and consequently successive weft picks may be 1 - 5 mm apart. If this is a white filament of about 1000 Denier the improvement in visibility of colourless warps is surprising.

A similar effect would be obtained by having a mixture of white and colourless warps. The filament used in the tape or wire construction is rendered white by incorporation of titanium oxide from 2 - 5% by weight. We prefer a 3% content to give a British Standard white known as 9/102. The strands of metal wire may be naked, covered only by alternate weft picks.

As the cost of copper is higher than stainless steel an increase in copper content raises the manufacturing cost steeply. The following combinations for a maximum twelve conductors are set out below:

Number of High Conduction Strands	Number of Tensile Strands
2	3
2	4
2	5
2	6
2	7
2	8
2	9
2	10
3	3
3	4
3	5
3	6
3	7
3	8
3	9
4	4
4	5
4	6
4	7
4	8
5	2
5	5
5	6
5	7

DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

Figure 1: is a front view of a portion of a fence tape,

Figure 2: is a front view of a portion of fence wire with the strands partly untwisted,

Figure 3: is a front view of a portion of a braided fence wire with the strands partly untwisted.

DESCRIPTION OF THE EMBODIMENTS

Twenty warp strands of 1000-1100 Denier polyethylene filaments 2 are woven on a ribbon weaving machine into a ribbon 12 mm wide using a weft 4 the same material which engages a lock strand 6. The weave is simple over/under; all the filaments contain 3% by weight of titanium dioxide giving a white corresponding to British Standard 9/102. A small mixture of brillance enhancer is incorporated. Three central strands of tinned copper wire 8 have a gauge approximating to the Denier of the tape and four stainless steel wires 10 are incorporated into the warps, one at each selvedge, and two intermediate strands. The tape is stiff enough to resist curling across its width and maintains a substantially flat ribbon confirmation when released from all tension. The tape is dispensed from a reel and mounted on fence posts using insulators in known manner.

A unidirectionally twisted multistrand fence wire is made of three strand groups 12 each consisting of a bunch of five white polyethylene monofilaments 14 each of a 1000 Denier. Each strand group contains at least one copper wire 8 0.25 mm in diameter and stainless steel wires 10 0.15 mm in diameter. Each copper wire is annealed and tinned. The wires are unidirectionally twisted with the monofilaments making a total of three stainless steel wires and six copper wires. Laboratory tests show that the D.C. resistance of wire containing six stainless steel strands each .015 mm in diameter is 6.38 ohms/metre. The same test shows the wire according to the above embodiment to have a D.C. resistance of 0.15 ohms/metre.

In figure 3 seven strands each consisting of a bunch of polyethylene monofilaments are braided together with three copper wires 8 and six stainless steel wires 10.

When a fence is erected with four tapes, white, orange, yellow and yellow and black stripe under field conditions, the perspective photograph of the fence retreating into the distance shows the white tape to be visible for the farthest distance, well beyond the point where the coloured tapes along side have ceased to be visible.

We have found the advantages of the above embodiments to be:

1. Acceptable resistance to tension.
2. Improved electrical conductivity over a six strand stainless steel version.
3. Minimum difficulty with electrolytic activity between the dissimilar metals.

4. Good visibility even in overcast, dusty or misty conditions.

Claims

1. An electric fence tape or wire comprising a textile support structure (2,4,12,14) and two groups of spaced conductive filaments (8,10) threaded or braided with the support structure so that the filaments are exposed at intervals along the structure and spaced apart but in close proximity with respect to one another, characterised in that each of the said two groups of conductive filaments has distinct mechanical and electrical qualities, wherein the first group of the filaments has superior electrical conductivity relative to the second and the second group of the filaments has superior resistance to tensile force relative to the first, and wherein the first and second groups each contain at least two filaments, whereby the electric fence tape or wire offers resistance to tensile forces while maintaining relatively good electrical conductivity.

2. An electric fence wire or tape as claimed in claim 1, wherein the support structure is in the form of a ribbon comprising woven textile strands.

3. An electric fence wire or tape as claimed in claim 2, wherein the weave of the textile strands of the ribbon is such that the tape is stiff enough to resist curling across its width, and so that the tape maintains a substantially flat ribbon configuration when released from tension.

4. An electric fence wire or tape as claimed in claim 1, wherein the support structure comprises a plurality of textile strands braided together.

5. An electric fence wire or tape as claimed in any one of claims 2 to 4, wherein the textile strands of the support structure are formed from a polyolefin, a polyester or a polyamide.

6. An electric fence wire or tape as claimed in any one of the preceding claims, wherein the tape or wire contains a white filler for enhancing visibility of the tape or wire.

7. An electric fence wire or tape as claimed in any one of the preceding claims, wherein the first conductive filament comprises one or more of copper, aluminium or aluminium alloy, and the second conductive filament is of stainless steel.

8. An electric fence wire or tape as claimed in Claim 7, wherein the first conductive filament comprises a multistrand filament of copper, and the second conductive filament comprises a multistrand filament of the stainless steel.

Patentansprüche

1. Elektrisches Zaunband oder elektrischer Zaundraht mit einer textilen Tragstruktur (2,4,12,14) und zwei Gruppen von leitenden beabstandeten Fasern (8,10), die aufgefädelt oder umflochten sind mit der Tragstruktur, so daß die Fasern in Intervallen entlang der Struktur frei und beabstandet, jedoch in großer Nähe bezüglich zueinander angeordnet sind, **dadurch gekennzeichnet**, daß jede der beiden Gruppen von leitenden Fasern bestimmte mechanische und elektrische Eigenschaften aufweist, wobei die erste Gruppe von Fasern eine größere elektrische Leitfähigkeit bezüglich der zweiten und die zweite Gruppe der Fasern einen größeren Widerstand bezüglich Dehnungskräften bezüglich der ersten aufweist, und wobei die erste und die zweite Gruppe jeweils wenigstens zwei Fasern aufweist, wodurch das elektrische Zaunband oder der elektrische Zaundraht einen Widerstand gegenüber Dehnungskräften bildet, während er eine relativ gute elektrische Leitfähigkeit beibehält.

2. Elektrischer Zaundraht oder elektrisches Zaunband nach Anspruch 1, wobei die Tragstruktur in der Form eines Bandes ist, das gewebte Textillitzen aufweist.

3. Elektrischer Zaundraht oder elektrisches Zaunband nach Anspruch 2, wobei die Webart der textilen Litzen des Bandes derart ist, daß das Band steif genug ist, einem Aufrollen über seine Breite zu widerstehen, so daß das Zaunband im wesentlichen eine flache Bandausgestaltung beibehält, wenn es von der Deh-

nung befreit wird.

4. Elektrischer Zaundraht oder elektrisches Zaunband nach Anspruch 1, wobei die Tragstruktur eine Mehrzahl von textilen zusammengewebten Textillitzen aufweist.

5. Elektrischer Zaundraht oder elektrisches Zaunband nach einem der Ansprüche 2 bis 4, wobei die textilen Litzen der Tragstruktur aus Polyolefin, einem Polyester oder einem Polyamid gebildet sind.

6. Elektrischer Zaundraht oder elektrisches Zaunband nach einem der vorhergehenden Ansprüche, wobei das Band oder der Draht einen weißen Füller aufweist zum Verbessern der Sichtbarkeit des Bandes oder Drahtes.

7. Elektrischer Zaundraht oder elektrisches Zaunband nach einem der vorhergehenden Ansprüche, wobei die erste leitende Faser einen oder mehrere Bestandteile aus Kupfer, Aluminium oder Aluminiumlegierung aufweist und die zweite leitende Faser aus nichtrostendem Stahl besteht.

8. Elektrischer Zaundraht oder elektrisches Zaunband nach Anspruch 7, wobei die erste leitende Faser eine mehrlitzige Faser aus Kupfer, die zweite leitende Faser eine mehrlitzige Faser aus nichtrostendem Stahl aufweist.

Revendications

1. Une bande ou un fil électrique de clôture comprenant une structure de support en textile (2, 4, 12, 14) et deux groupes de filaments conducteurs espacés (8, 10) enfilés ou tressés avec la structure de support de telle manière que les filaments sont à découvert à des intervalles le long de la structure et écartés mais à proximité immédiate les uns par rapport aux autres,
caractérisé en ce que chacun desdits deux groupes de filaments conducteurs a des qualités mécaniques et électriques distinctes, le premier groupe de filaments ayant une conductivité électrique supérieure par rapport au second, et le second groupe des filaments ayant une résistance supérieure aux forces de traction par rapport au premier, et le premier et le second groupes comprenant chacun au moins deux filaments, grâce à quoi la bande ou le fil électrique de clôture présente une résistance aux forces de traction tout en maintenant une relativement bonne conductivité électrique.

2. Un fil ou une bande électrique de clôture tel que revendiqué dans la revendication 1, dans lequel la structure de support est sous forme d'un ruban comprenant des brins textiles tissés.

3. Un fil ou une bande électrique de clôture tel que revendiqué dans la revendication 2, dans lequel le tissage des brins textiles du ruban est tel que la bande est suffisamment raide pour résister à une ondulation en travers de sa largeur, et de telle manière que la bande conserve une configuration de ruban sensiblement plat lorsqu'elle est libérée de toute tension.

4. Un fil ou une bande électrique de clôture tel que revendiqué dans la revendication 1, dans lequel la structure de support comprend une pluralité de brins textiles tressés ensemble.

5. Un fil ou une bande électrique de clôture tel que revendiqué dans l'une quelconque des revendications 2 à 4, dans lequel les brins textiles de la structure de support sont formés d'une polyoléfine, d'un polyester ou d'un polyamide.

6. Un fil ou une bande électrique de clôture tel que revendiqué dans l'une quelconque des revendications précédentes, dans lequel la bande ou le fil contient une charge blanche pour augmenter la visibilité de la bande ou du fil.

7. Un fil ou une bande électrique de clôture tel que revendiqué dans l'une quelconque des revendications précédentes, dans lequel le premier filament conducteur contient un ou plusieurs des corps du groupe du cuivre, de l'aluminium ou d'un alliage d'aluminium, et le second filament conducteur est en acier inoxydable.

8. Un fil ou une bande électrique de clôture tel que revendiqué dans la revendication 7, dans lequel le premier filament conducteur comprend un filament à plusieurs brins de cuivre, et le second filament conducteur comprend un filament à plusieurs brins de l'acier inoxydable.

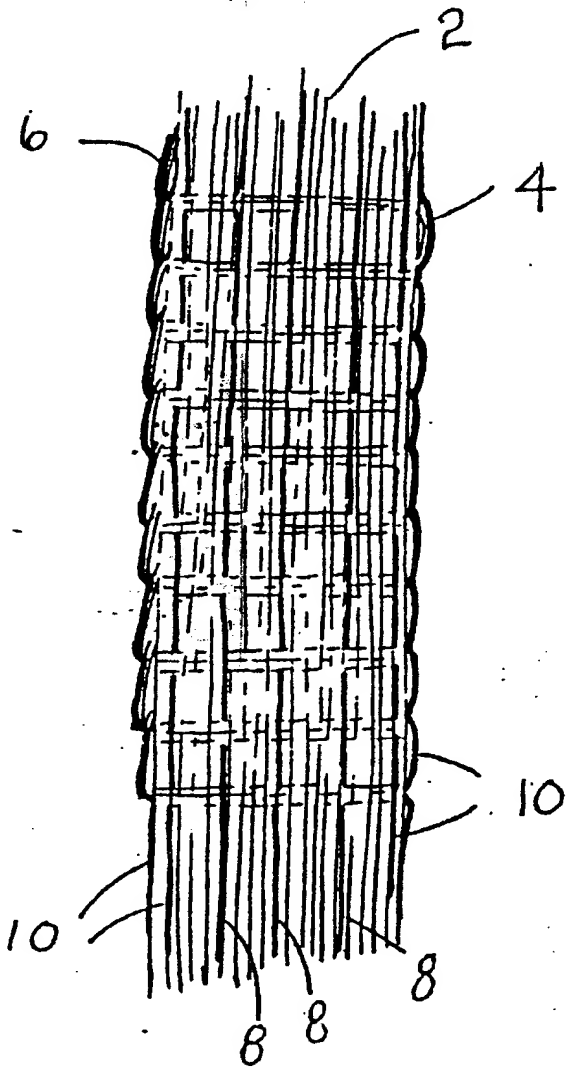

FIG 1

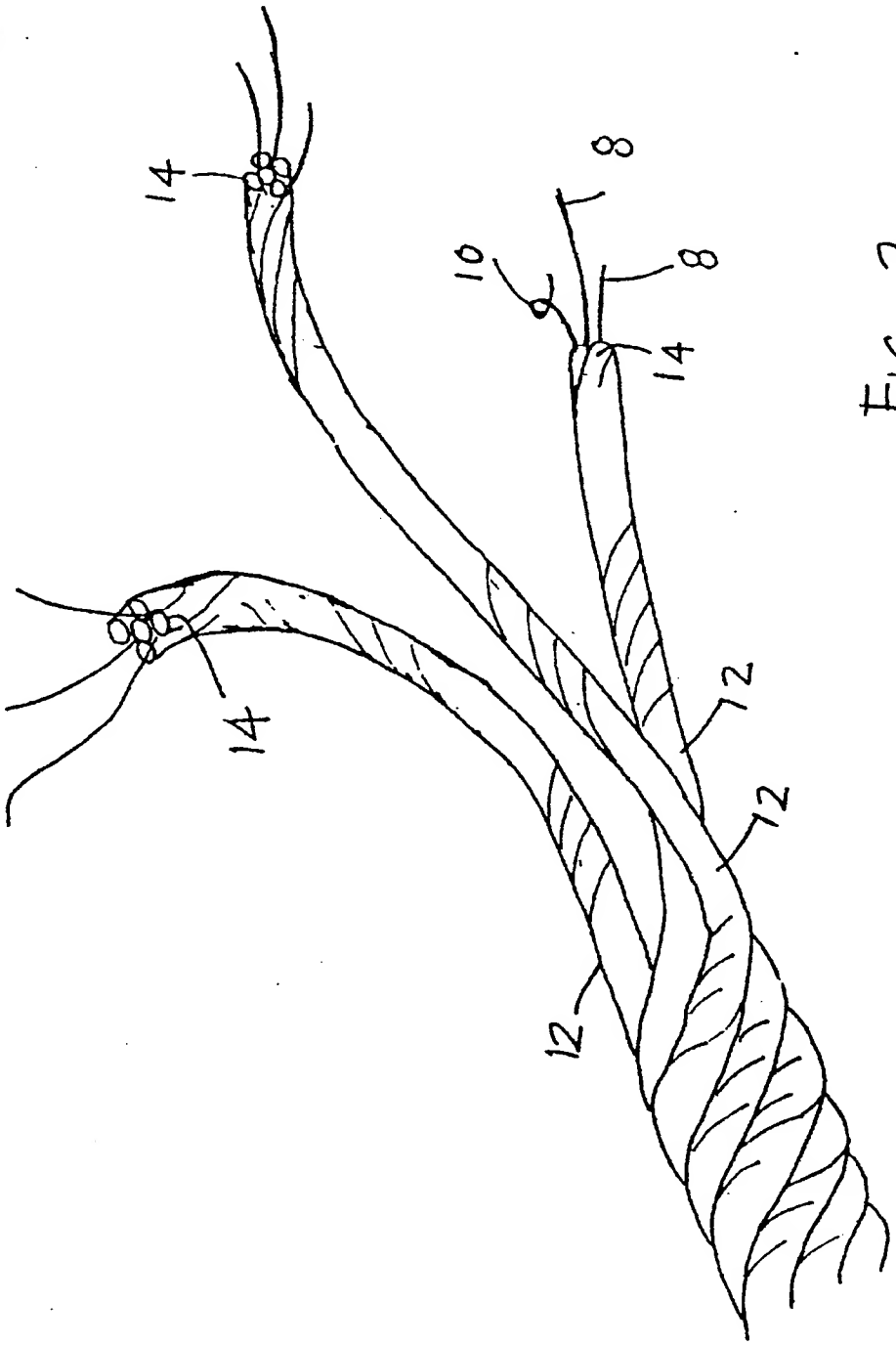

FIG 2

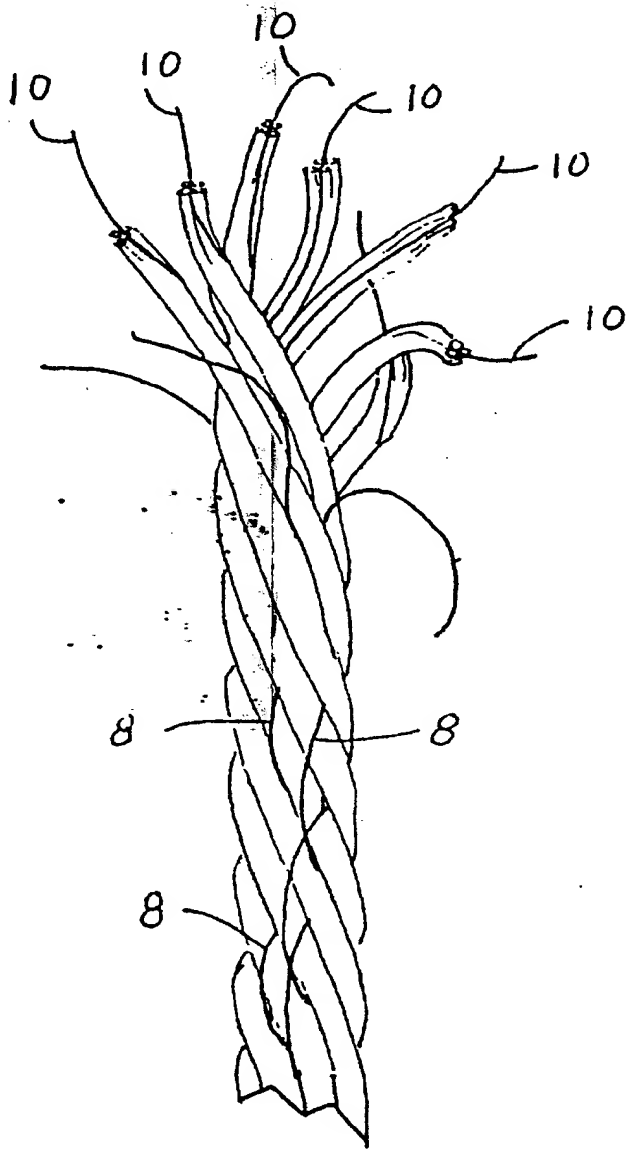

FIG 3